Volume 26 Part 1

2008

SPECIAL MONITORING EDITION

NCSSA major concerns include

- **Native vegetation, threatened species and habitats**
- **Protecting all forms of life (biodiversity) on land and in the oceans**
- **Park dedication, management and legislation**
- **Education about biodiversity to all sections of the community**
- **Cooperation with other conservation groups**

Inside this issue:

Around NCSSA

The NCSSA has moved!
After over 20 years at 120 Wakefield Street, the Nature Conservation Society of South Australia has moved house.

Our new office is at 260 Franklin Street Adelaide ~ one of three adjoining cottages located near the West Terrace end of Franklin Street.

Phone numbers have changed also. Our new main Phone number will be 08 7127 4630 and our fax number will be 08 8231 9773.

Doors opened at our new premises on Monday 18th February.

Autumn Activities at NCSSA

To celebrate the relocation, we are having a party! Please bring your friends and family to see the new premises and meet our members and staff.

Activity: NCSSA Official Opening Party. Nibbles and drinks provided.

Date: Wednesday 30th April from 5:30pm

Location: 260 Franklin Street, Adelaide

RSVP: tinabentz@gmail.com by 18th April

2008 General Meetings
will be held at the University of Adelaide. Following NCSSA's successful February meeting which ran in conjunction with the *Biology Society of South Australia*, the NCSSA will be participating in further joint meetings with the Biology Society during May and November 2008.

The next meeting will be the awarding of the 2008 NCSSA Conservation Biology Grant, and BSSA Field Research Grant. Presentation**:** Past award winners of the NCSSA Conservation Biology Grant, and BSSA Field Research Grant present their research. See the back of this edition for details.

NCSSA people

Management Committee

President Helen Vonow
Vice-President Katie Fels
Secretary Nicole Lewis
Assistant Secretary Sue Graham
Treasurer Richard Winkler

General committee
Misch Benito, Zoe Drechsler, Ben Taylor, Caroline Wilson

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Bushland Condition Monitoring Manual Trainer Janet Pedler
MLR Woodland Bird Survey Coordinator Tina Bentz
2007 South East Survey Kerry Gilkes and Georgie Green
Database & Website Project Officer Lesley Parton
Plotless Density Counts Project Officer Craig Gillespie

BIODIVERSITY MONITORING SPECIAL EDITION

This special edition of *Xanthopus* is devoted to an overview of the biodiversity monitoring projects that the Nature Conservation Society runs. Whilst the subject matter may be a bit dry for some, the fact is that these programs are a major part of the Society's current activities, and are providing positive outcomes against the objectives of the Society. One common thread that is obvious through all of the articles is that the Society is actively engaging the community in monitoring – from the 300 people from a variety of backgrounds who have been trained in the Bushland Condition Monitoring method to the highly skilled ornithologists who gather data for the Mount Lofty Ranges Woodland Bird Monitoring project. This is not only building capacity to monitor biodiversity over time, but is also substantially improving community knowledge and understanding of biodiversity – for example, feedback from Bushland Condition Monitoring workshops has indicated that over 85% of participants had learnt new skills and concepts, and over 75% indicated they would change their actions as a result of the workshop.

Notwithstanding this, the value of long term monitoring data will be invaluable – picture if someone had compiled the dataset for Mount Lofty Ranges woodland birds fifty years ago and what lessons we would have learnt now.

By being actively involved in biodiversity monitoring, the NCSSA is building our biodiversity knowledge, understanding and ability to act to preserve, in both the short and long term future.

Monitoring Vegetation Condition: A Question of Trade-offs

Designing a monitoring protocol or program is usually an exercise in balancing a range of scientific, management and cost considerations. Few monitoring programs have unlimited resources, begin with adequate knowledge of the parameters to be monitored, or know with certainty how or when the results the will be used. Interest in monitoring change in vegetation condition has increased in recent years with greater general interest in the health of natural systems and with greater requirement for accountability to outcomes from investments in natural resource management (eg. National Natural Resource Management Monitoring and Evaluation Framework, 2003). Information on change in vegetation condition is required for a range of purposes and at a range of scales, from the site scale to inform land managers to the regional and national scale to inform planning and investment processes.

While monitoring protocols and programs can be designed to detect a broad suite of changes to inform a broad range of interests, the most cost-effective approach requires a clear understanding of the objectives of the monitoring and the costs of collecting or not collecting information adequate to meet the objectives. With clear objectives in mind, designing a monitoring protocol or program can proceed to determining the trade-offs that need to be made.

Perhaps the most commonly considered trade-off for vegetation condition monitoring is between the method of sampling and the cost of data collection (in time, money or other resources). For indicators of vegetation change such as percentage cover some studies have demonstrated that methods such as sub-plot frequency (ie. dividing a plot into smaller sub-pots and counting the number of sub-plots which contain a species of interest; or variations on that theme) can be more precise or accurate than visual estimation but it can take up to five times longer to collect the data (Bråkenhielm & Qinghong 1995; Carlsson et al, 2005). The choice between sampling methods then becomes a choice about the level of accuracy or precision required versus the value of collecting data at more sites or at the same site more often (Tyre et al (2003) have illustrated some of the trade-offs to be considered when deciding between visiting additional sites or revisiting sites more often).

An associated trade-off for vegetation condition monitoring is between the level of expertise required for some data collection methods (and the associated costs of hiring experts) and the level of observer bias or sampling error. Expert assessors may be more accurate than less expert or experienced assessors for measuring indicators such as species presence/absence but the difference may be small relative to the problems of cost or availability of expertise, and for abundant and easily recognized species the differences negligible (Ringvall et al, 2005). Ringvall et al (2005) showed that less expert surveyors recorded approximately 5% mean systematic errors for the most difficult to detect species (using a presence/absence method), compared to around 3% mean systematic error for more expert surveyors making measurements on the same plots. Considering the potential costs of training to an expert level or accessing expert and experienced assessors, small increases in sample error or observer bias may be tolerable depending on the amount of change which it is deemed important to detect. The benefits of using methods which can be easily learned by a greater number of people will eventually outweigh the costs of observer bias and sampling error if the number and frequency of sites surveyed can be greatly increased and the size of changes of interest is large enough. Assessors with less experience could also receive additional, well targeted, training to improve accuracy and precision, a cost effective and strategic approach adopted by the NCSSA Bushland Condition Monitoring Program.

An additional benefit of using a monitoring protocol which can be easily learned by inexperienced assessors is the opportunity to build awareness and knowledge and inform direct action. Training private landholders to measure changes in vegetation condition on their own properties can provide feedback on actions, encouragement for good practice, and lead to adaptive management. Individuals

Monitoring Vegetation Condition cont.

making reassessments of the same limited number of sites may also have greater consistency of error or bias than randomly selected assessors, or may become more accurate and/or precise over time as their experience increases. Both of these outcomes have the potential to improve the chances of detecting a change of interest at a given site if one occurs. Assessors with ongoing commitment to manage the site they are monitoring are also likely to take note of changes outside the scope of the monitoring protocol and are able to link knowledge of management actions to the changes observed – a luxury not often available to 'expert' monitoring programs. Separating the processes of knowledge gathering from management may be necessary for large institutional managers of native vegetation, but it is an unnatural approach for landholders engaged in primary production and for lifestyle landholders who are enthusiastically trying to manage and restore their bushland.

Ongoing commitment to monitoring programs is another area where the right decisions about trade-offs can influence long-term success. The program monitoring woodland birds in the Mt Lofty Ranges which is managed by the NCSSA has taken a long-term approach to detecting changes of interest in as many woodland bird species as possible after given time intervals. Field et al (2007) show how maintaining a manageable number of survey sites, assessed using a standard and optimised method, allows determination of the length of time required to detect a 30% change in the population of different species with a known level of confidence. This program trades the ability to detect relatively small changes in populations, changes in species which are difficult to detect and changes in species of low or highly variable abundance with a relatively low cost/high confidence ability to detect changes of interest in a suite of species of interest. The woodland bird monitoring program also trades off the ability to detect changes in the relatively short term (<5yrs) with the high cost of the sampling regime which would be needed to detect changes over that period.

The design of monitoring programs does not need to remain static but can benefit from an 'adaptive monitoring' approach where information collected during early monitoring can be analysed and used to improve and/or make the protocol or program more efficient. This has been done for a program monitoring fox populations on Eyre Peninsula (Field et al, 2005) and demonstrates the importance of including the costs of (early) analysis and of intensive early data collection (with the potential to reduce the intensity when the design has been optimised) when considering the trade offs in the program design (Field et al, 2007).

Monitoring protocols and programs have a choice about whether or not they: provide training (awareness and skills) to a greater number of people; deliver information about changes directly to managers (as opposed to data mining exercises divorced from management); have a high probability of linking changes detected to information about current and historic management actions; consider the type and size of changes which need to be detected; are designed to return confident results when they are most useful or most cost-effectively available; can be sustained in the face of uncertain funding cycles. By considering the trade-offs listed here and elsewhere, monitoring protocols and programs can be designed to be useful and not simply accurate. Trade-offs must be considered in the light of the objectives of the program and perhaps it is necessary to describe what the objectives are not (1 – objectives) to ensure designs remain focused and innovation is not stifled.

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P.J. O'Connor

XANTHOPUS

The views presented in this newsletter are not necessarily those of the NCSSA

Copy deadline for the Winter edition is **12th May** 2008.
Contributions in a variety of formats will be considered, but electronic submissions are preferred.

Editorial Team for this issue: Tim Milne, Annie Bond and Helen Vonow.

Please let us know if you would prefer to have your *Xanthopus* emailed in preference to a hard-copy
~ we are considering this as an environmentally friendly option.

Vegetation Monitoring Program in Mokota Conservation Park 2000- 2005

Mokota Conservation Park in the Mid-north of South Australia was created to conserve native irongrass (*Lomandra* spp.) grassland, which has recently been listed as a critically endangered ecological community. The Park area had a history of livestock grazing for more than a century, but this grazing was removed prior to purchase in 1998. The Nature Conservation Society of South Australia lobbied extensively at this time to ensure that there was a program of adaptive management implemented at the site, to ensure that the high conservation values that were identified at the time of the Park purchase were not compromised by this de-stocking.

In 2000 the NCSSA also established a vegetation monitoring program to quantify a baseline and record trends in plant biodiversity over time following this change in management. An initial pilot study was conducted with Jose Facelli from the University of Adelaide to settle upon a methodology that would be suitable for this long term monitoring. This lead to a method whereby paired, permanent plots were established in both sparse, species-rich, mainly native grassland and dense, species-poor, mainly alien grassland nearby. Thirty six plots of six metre square were established in total, and were sub-sampled using 25 thirty centimetre square quadrats. Frequency of all native and alien vascular plant species was recorded in each quadrat in late spring from 2000-2003 and in 2005.

The following is a summary of the results obtained to date from this monitoring.

Native species richness was significantly greater in sparse than in dense grassland plots in all years. Native annuals were virtually absent from dense grassland (fewer than one species per plot). There was generally little variation over time in plot species richness, but it was reduced in 2002, consistent with the effect of seasonal conditions on abundance of some annual species. Multivariate analysis of all plant frequency data does not indicate that composition of sparse and dense plots is converging over time. Most species were recorded in the same plots each year and changes in their frequency each year were small in comparison to the variability between plots. Many plant species were low in total abundance and patchy in distribution. Multivariate analysis of plant frequency data has also indicated that there were six alien species and one native perennial grass that were characteristic of dense grassland plots, compared to twenty two native species (including five grasses), one alien perennial (**Romulea* sp.) and three alien annuals (including two fine grasses **Aira* sp. and **Vulpia* sp.) that were characteristic of sparse grassland plots (ie those that were in good condition).

In 2003, frequency of the native Brush Wire-grass, *Aristida behriana*, which is summer-active, in both dense and sparse grassland was lower than in previous years but increased in 2005. Rough spear grass *Austrostipa scabra*, a grass that is more common in sparse grassland, was generally more abundant in 2005. Native wheatgrass *Elymus scabrus* continued to increase in 2005 in the eastern sparse and dense grassland. Wallaby grasses do not appear to have decreased or increased over time. In 2005 the frequency of many native and alien annual forbs was generally reduced, but clovers, **Trifolium* spp. remained abundant, especially hop clover **Trifolium campestre*.

Of the ten native species of conservation significance at the regional level, most species decreased slightly over the monitoring period. This included Little Buttons *Leptorhynchos tetrachaetus*, the only significant annual species, and the perennial Behr's Swainson-pea *Swainsona behriana*, a vulnerable species at the state level. Only *Austrostipa setacea* increased in 2005.

Thus the first six years of comprehensive monitoring data from Mokota Conservation Park show some general trends, but further long term monitoring of the grassland is important to take account of seasonal variations, including unusual rainfall events and the large number of plant species present. Climate data indicates that summer rainfall of 100-200mm occurs, on average, one year in ten (Bureau of Meteorology, 90th percentile for rainfall December to February). Summer of 2005/2006 was such a year, while significant summer rainfall also fell in January 1995. Rainfall for the month of January 1993 and the total for 1992 were the highest on record respectively. Summer rainfall for the period 2000-2003 was between 29mm and 62mm, near the median of 50mm.

Further monitoring data is needed to indicate whether favourable climatic conditions could bring about native perennial plant recruitment under the current management regime.

ACKNOWLEDGMENTS

The following contributions to the project were essential and are appreciated.

Field Assistance 2003: Susan Gray.
Field Assistance 2004: Amber Clarke, Michael Wiggs, Kate Burton and Jasmine Winter, all DEH Yorke Mid-North Region.
Statistical analysis: Dr. Jose Facelli, University of Adelaide; Robert Brandle, Dr. Wendy Stubbs and Andrew West, DEH
DEH Burra: Ian Falkenberg and Michael Freak.
Grassy Ecosystems Technical Advisory Group (GETAG) – particularly Annie Bond, Dr. Andy Sharp, Rick Davies and Ryan Incoll.
Assistance with plant voucher identification: Rosemary Taplin and Helen Vonow.
Nature Conservation Society of South Australia Inc. (NCSSA) steering group: Helen Vonow, Elizabeth Lonie.
Native Vegetation Research Fund: Grant - Monitoring, years 1-3
Wildlife Conservation Fund, National Parks and Wildlife Advisory Committee - grant for field component of monitoring, 2005 and partial reporting.
DEH: contribution to field assistance, travel and reporting.
National Parks and Wildlife Service SA Research Permit No. E24414 4

Meg Robertson

Why monitor the woodland birds of the Mount Lofty Ranges?

Introduction

Australian woodland birds are widely considered to be under serious threat (Olsen *et al.* 2005). The Mount Lofty Ranges (MLR) is an outlying island of woodland that has lost, and is expected to lose, a significant fraction of its avifauna (Ford & Howe 1980, Paton *et al.* 1994, Possingham & Field 2000, Black 2005). The Mount Lofty Ranges contain no endemic bird species. However, the MLR do contain some endemic subspecies and many isolated populations of species typical of wetter woodlands and forests (Schodde & Mason 1999). One of these, the Mount Lofty Ranges Spotted Quail-thrush may well have recently become extinct (last record 1984, not that anyone seems to have noticed).

Less than 20% of the original MLR vegetation remains – so the fate of its avifauna can be thought of as an indicator of the future fate of all of eastern Australia's woodland birds. If Azure Kingfishers and Spotted Quail-thrushes can disappear from the whole Mount Lofty Ranges, maybe they are also vulnerable elsewhere.

In 1999, funded by an Australian Research Council (ARC) Discovery grant, we began to monitor woodland birds in the Mount Lofty Ranges. Since then the project has been funded further by the ARC, the Department of Environment and Heritage (SA), The Nature Foundation (SA), The University of Queensland (UQ), the Adelaide & Mount Lofty Ranges Natural Resources Management (AMLR NRM) Board and the Birds for Biodiversity project (through the Conservation Council of SA). Further funds have been obtained through the NRM Board to continue the survey to 2010 – **but why?** *What is the point of monitoring anything?*

This article will try to answer that question, discuss some preliminary results of the work to date, and present some ideas about what we hope to achieve in the future.

A rough map of the 150 plus survey sites is shown in Figure 1 (squares represent gum woodland sites, triangles are sites dominated by stringy bark). Each site is 2ha and is surveyed for 20 minutes following the standard Birds Australia Atlas method. However we try to record exact numbers, as well as information on species heard or seen outside the 2ha, breeding in the patch or flying over.

Why monitor the woodland birds of the Mount Lofty Ranges?

There has been considerable scepticism about the value of monitoring biodiversity. Some argue we should stop all the monitoring and simply take action. We believe that monitoring plays a variety of essential roles including:

1. The general public want to know how things they value, like birds, are faring. Indeed DEH has a stated that they are committed to monitor regional trends and this survey is one of their few regional programs.
2. The Federal Government and co-investors in the National Heritage Trust (NHT, like DEH and the NRM boards) need to know if their on-ground actions are abating declines in biodiversity.
3. Monitoring can provide more formal evidence of declines of species that would otherwise rely on hearsay or expert opinion.
4. Evidence for a decline provides information to help determine the cause of the decline and the actions that are needed to abate that decline.
5. Monitoring across the whole MLR provides a platform for testing specific biodiversity recovery actions, like fox baiting or revegetation, in before-after control-impact experimental design.

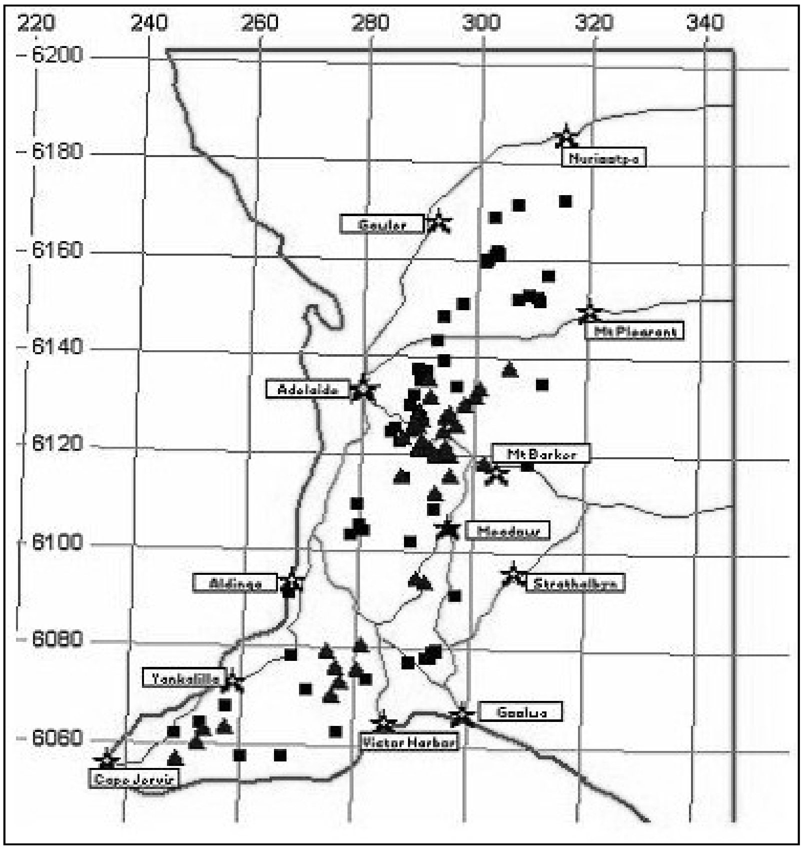

Figure 1. Some MLR Declining Woodland Bird Monitoring Sites.

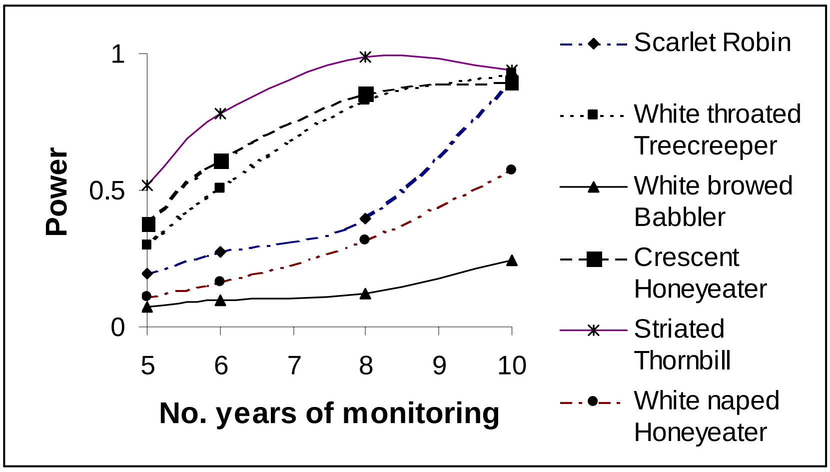

Figure 2. Statistical power to detect a 30% change in conservation status of varies species of woodland bird in the Mt Lofty Ranges, South Australia, as a function of the time spent monitoring. (Figure 3 *in* Field *et al*. 2007).

What have we learnt so far?
We are unable to answer the really big question – how well are common birds in the Mount Lofty Ranges faring? Why? – because you generally cannot discern long-term trends in animal abundances with less than ten years of data. Figure 2 below from Field *et al.* (2007) illustrates this fact. It shows how many years of data we would need, given the current monitoring program of about 150 sites visited three times a year each, to separate a decline of 30% over a ten year period from the natural inter-annual variability (background noise due the environment, variable observers, weather, etc.). This is a measure of the "statistical power" of the monitoring program. It measures our ability to pick up real changes of a particular size above and beyond natural fluctuations and measurement error. With seven years of data collated we are just getting to a point where significant changes, if they are occurring, should be discernable in common and moderately common species like the Crescent Honeyeater or Scarlet Robin. Picking up trends in uncommon species, like the White-browed Babbler, will take longer. This highlights the importance of keeping monitoring going for a long time. While pure research agencies like the Australian Research Council can be used to fund the start of projects like this – long-term commitments from government, regional bodies, non-government organisations and foundations are essential to regional monitoring success.

In the meantime the data has been useful for answering several more generic and fundamental questions about bird monitoring and monitoring in general. We have used the data to inspire the development of new statistical methods (Tyre *et al.* 2003, Martin *et al.* 2005, Field *et al.* 2005) and that work has already attracted numerous citations in the international literature (53, 14 and 12 citations to those papers alone). This means the research is having a global impact on how we monitor biodiversity.

Early in the survey process we tried some variations on the monitoring method to see what was most cost-efficient for picking up changes and true absences of bird species from sites. Investing in fewer, long visits to sites has the problem of lack of replication. Lots of visits to a few sites mean that our results may not give a good picture across the whole region. We have found that 150 sites with three visits per site is a useful compromise, although there is room for expansion into specialised habitats and more disturbed habitats.

The future
There are at least three broad areas where we hope to see more outcomes in the near future: detecting long-term changes, assessing the value of conservation management, and improving the theory and practice of bird monitoring generally.

The next three to five years may provide definite proof of significant changes in abundance and set a platform for determining the effect of landscape scale management. Providing evidence that our investment in biodiversity conservation is having an impact is absolutely essential for the long-term success of the NHT. This is one project that may be central to assembling that evidence since people who invest in things like to see returns. So, the Australian public do need credible evidence that their investment is delivering biodiversity outcomes, or otherwise (Field *et al.* 2007). As stated above, statistically significant trends are only likely to be detected after more than 10 years, so analyses of the data over the next few years will be crucial.

Now that we are on the way to have a solid understanding of natural fluctuations in bird densities in natural habitat across the Mount Lofty Ranges, we can use these data as benchmarks for assessing conservation actions – like revegetation, fox-baiting or weed control. For example, how does the bird community of revegetated sites compare with the bird community in natural sites? If we separate out sites that are, or will be, baited for foxes, can we see the impact of that treatment on the bird fauna? Indeed there are a myriad of projects that could build on this data, projects that would otherwise have no previous/control/baseline data, and hence have trouble picking up real impacts of conservation management from natural fluctuations.

Why monitor the woodland birds of the Mount Lofty Ranges? cont.

We continue to use the data to explore more fundamental questions about bird surveying. For example, one of the postdoctoral fellows at UQ, Dr Judit Szabo, is using the data to ask the question – "How does systematically collected bird data differ from data collected as part of more ad hoc data sets like the Australian Bird Atlas?"

For more information about the project and details of the survey method (and a copy of all the data) see:

(http://www.ecology.uq.edu.au/index.html?page=65812&pid=20910).

Thanks

Many people have contributed to this project so far — too many to list.

For the past three seasons, the survey was capably organised by Tina Bentz as an employee of the NCSSA.

Many paid and unpaid observers collected the data enduring early morning starts and frustrating weather.

Max Possingham has ensured the data is checked and curated, an essential but tedious task.

Tim Milne, Patrick O'Connor and the NCSSA staff and committee have been instrumental in keeping it alive during this critical phase.

I am particularly grateful to the NCSSA for managing this project and the generous support of the Department of Environment and Heritage (SA), The Nature Foundation (SA) and the Adelaide & Mount Lofty Ranges Natural Resources Management Board that enables it to continue into an exciting new phase.

And AEDA – The DEWR funded centre for Applied Environmental Decision Analysis covers analyses and web hosting of data (www.aeda.com.au).

A special thanks to landowners as continuity is of the essence for long-term monitoring programs such as this, so their ongoing help is greatly appreciated.

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Some publications using our MLR woodlands bird survey data

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Can I tell if my bush is changing?

Using the Bushland Condition Monitoring Method - a Preliminary analysis of field results

There are a number of articles in this edition of *Xanthopus* that provide insights based upon the use of the Bushland Condition Monitoring Method (BCMM) published by Croft *et al* 2005. Whilst this methodology is based upon widely used techniques, such as the Braun Blanquet scale for measuring cover /abundance as used by the Biological Survey of SA (BSSA; Heard and Channon 1997), it is recognised that ongoing testing and evaluation of the methodologies contained within the Manual is worthwhile to help evaluate the power of the BCMM to detect change, and to appropriately refine and modify the methods used, and training provided.

This article is a preliminary analysis of a trial that had been conducted in conjunction with Jackie Watts of the University of Adelaide as part of ongoing testing and evaluation of the BCMM. The aim of the trial was to gain insights into surveyor consistency as well as the ability of surveyors to detect differences between different sites. This would provide an indication of the ability of the BCM method to detect real change at a site, as compared to change that may be due to the skill or bias of different observers.

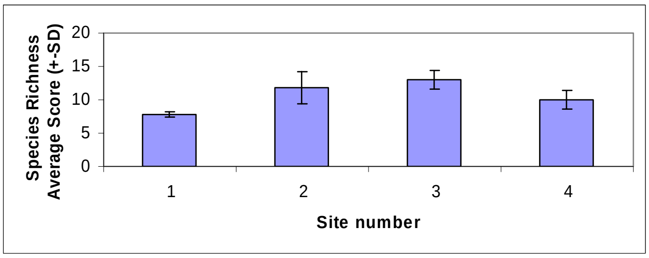
Five different practitioners who had been trained by NCSSA and had been using the BCMM in field situations independently scored four different sites that had been marked out within an area of the Waite Reserve in the Adelaide Hills. Each of these sites belonged to a similar vegetation association (*Eucalyptus camaldulensis / Eucalyptus leucoxylon* woodland) but were chosen to represent different condition classes, although all sites were visually assessed to be in overall poor to moderate condition, and so did not represent a full suite of possible condition classes.

Native Plant Species Richness

The BCM method counts all native plants in a 30 metre by 30 metre plot, in a similar way to the standard BSSA method (as per Heard and Channon 1997, although note that cover and abundance details are also collected using the BSSA method).

Figure 1 shows that the average species richness counts for the four sites ranged from 7.8 in site 1 to 13 in site 3.

Figure 1: Mean Species Richness Scores for five different observers



There was a significant difference amongst both observers (analysed by two-way Analysis of Variance (ANOVA); F=5.16, df=4, P=0.01) and sites (F=20.1, df=3, P<0.0001). This means that some observers consistently scored fewer species than others, but observers also consistently scored some sites as different from other sites.

The observer bias is not unexpected as many previous studies have noted that species richness counts can be highly variable depending on the skill of the observer (eg Ringvall *et al* 2005 as discussed by O'Connor in this issue). However, there were compelling reasons to include species richness counts and a list of species in the Bushland Condition Monitoring Method, including:

- To retain compatibility with the standard BSSA method (and hence potentially provide some added value to this extensive dataset)
- Recognising that most property managers/landholders most easily identify with a list of plant species as an indicator of the condition or biodiversity value of their site
- To provide opportunities to increase plant identification skills during training

Using the same observer to monitor a site over time may improve reliability of the species richness counts.

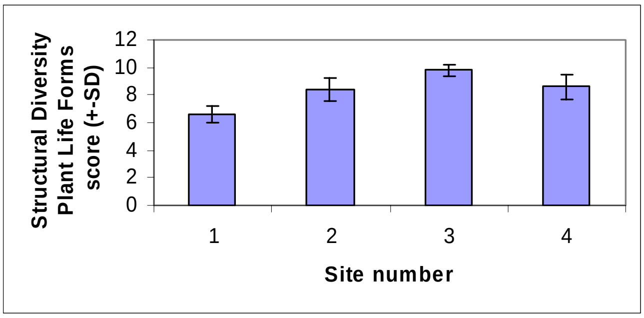
However, the interpretation of data collected by different observers will need to consider the effect of the skill of the user. Further data needs to be collected in a variety of different condition classes of different types of vegetation to confirm the effect of observer skill.

Can I tell if my bush is changing? cont.

Structural Diversity - Plant Life Forms

Structural Diversity – Plant Life Forms scores whether a plant life form (eg trees, shrubs, herbs, grasses) is present and what degree of cover that particular life form has. The final score represents the both the presence and degree of cover of different life forms.

Figure 2: Mean Structural Diversity Scores for five different observers



The four different observers had quite consistent final scores for structural diversity, whilst the average score for each site ranged from 6.6 to 9.8 (Figure 2). It should also be noted that all sites were in poor to moderate condition for the Plant Life Forms score, and in higher quality sites much higher scores would be expected. There was no significant difference among observers (analysed by two-way ANOVA; F=1.94, df=4, P=0.17), but there was a significant difference amongst sites (F=20.5, df=3, P<0.0001).

Put simply, this demonstrates that the Structural Diversity Plant Life Forms indicator showed no consistent bias between different observers, but there were consistent differences observed between the four different sites scored.

Tree Health

To score tree health, the different surveyors assessed dieback (as a percentage of foliage loss) in the 10 nearest trees to a marker post in each of the four sites. The BCMM Manual provides diagrams to assist in allocating this dieback percentage.

For statistical analysis the percentage data were arcsin transformed as proposed by Zar (1984). A two-way ANOVA, using the 10 trees at each site as replicates, showed significant differences amongst sites (F=4.17, df= 3, P=0.007), but no significant differences amongst observers (F=0.57, df=3, P=0.63) and there was no significant interaction between the two (F=0.09, df=9, P=0.99). This means that there was no consistent bias in any of the five observers tested, but there were significant differences in the degree of dieback of the ten trees sampled at the four sites.

The average standard deviation from the group mean of the observers for all 40 trees that were scored was 8.5%. This means that on average each of the observers scored 8.5% from the average of all of the observer scores for each tree. The average standard deviation from the group mean for all 40 trees was 32.5%, meaning that each tree in the group of 10 trees varied, on average, by 32.5% from the average dieback of all 10 trees. This indicates that the variability between observers is much less than the variability between different trees.

Statistical Power to detect change in tree health

Firstly, my apologies to many readers who may be finding this article a little too technical. Statistical power can be defined as the chance of detecting a change when a real change is actually occurring. Perhaps a good analogy is the chance of an alarm going off when it should actually go off.

Thus in this example, I used Power Analysis (using GPower) to analyse the data collected during this trial to see what the chances actually were of detecting a change in tree health based on scoring ten trees using the BCMM. Table 1 shows that using 10 trees alone, the power to detect a 10% change in tree health is quite low (63%; ie. Only a 63% chance of detecting a change as small as 10% if it occurred), but increases markedly when either the number of trees is increased to 40 (power = 75%) or the degree of change in tree dieback is 30% (power = 85%). Using the analogy above, if a 10% increase in dieback occurred and 10 trees were scored then the alarm would "go off" 63% of the time when it should, with a 37% chance of not "going off" when it should. Similarly if a 30% increase in dieback occurred and 40 trees were scored then the alarm would "go off" 98% of the time when it should, with only a 2% chance of not "going off" when it should.

Table 1: Predicted power of tree health data from this site to detect change (Note that α = β as discussed by Field et al 2007)

	Degree of Change in Tree Health	
Number of Trees Scored	Low (10% change in tree health)	High (30% change)
10	63%	85%
40	75%	98%

Thus whilst scoring 10 trees does provide some value in detecting changes which may be of interest to managers, the chance of detecting these changes can be greatly increased by increasing the number of trees scored. The single site score may also be of value if a decline is observed using only 10 trees, further trees could be incorporated into monitoring to increase power.

From a regional perspective the data are much more compelling – with only four sites established there is significant ability to be able to detect moderate change in tree dieback. Currently through the Bushland Condition Monitoring program data has been collected for over 2000 trees in the Mount Lofty Ranges. Over time, and with continued support of this program, data will not only help to identify long term trends in dieback, but will also help to clarify for which tree species dieback is a serious threat, and will help to track fluctuations in dieback levels for different species.

As mentioned previously, this is only the first analysis of these data, and forms part of an ongoing commitment to refining and improving the Bushland Condition Monitoring program co-ordinated by NCSSA.

However, even at this early stage, it is apparent that the method provides valuable and reliable data that can be used to assess and monitor changes of interest in specific attributes of bushland that are well accepted surrogates for biodiversity value.

With over 300 people trained, and over 400 sites established using the method to date in the South East, Mount Lofty Ranges, Murray Darling Basin, Mid North, Yorke Peninsula and Eyre Peninsula, there is already a substantial capacity to monitor native vegetation across the state.

In the next issue of *Xanthopus* we will present some of the data that has been collected to date at approximately 200 sites in the southern Mount Lofty Ranges and we will discuss the implication of some of these results.

She-oaks in various stages of health, Rockleigh - continued monitoring of these trees will help to track long-term trends in dieback
Photo: Tim Milne

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NCSSA Project Manager

Bushland Condition Monitoring of Bowman Park, Bordertown Parklands

This article describes two Bushland Condition Monitoring (BCM) sites at Bowman Park, Bordertown Parklands in the Upper South East of South Australia. The Parklands are crown land under the care of the Tatiara Council District. The sites were established in 2004 to monitor the biodiversity recovery of this area following 10 years of active conservation management. The monitoring sites were re-surveyed in 2006 and 2007.

Bowman Park: a grassy woodland jewel

For the past ten years, John and Moira Samuel-White have been managing an area of the Bordertown Parklands known as Bowman Park for conservation. This area of approximately 10 hectares conserves rare grassy woodland, dominated by Blue Gums, but with the regionally threatened, Buloke, Grey Box and River Box also present.

John and Moira, local naturalists and volunteers, were among the first to recognise the high conservation values of Bowman Park, when 10 years ago John was asked to identify the State Vulnerable and regionally Endangered Leafy Templetonia (*Templetonia aculeata*) which was present in the Park. At this time, Bowman Park was dominated by perennial exotic weeds and exotic herbaceous species, particularly Phalaris. The area had been intensively grazed for many years, and the topsoil had been removed from large areas of the Park.

Current Management

For the past decade John and Moira have spent hundreds of hours spot-spraying perennial grass weeds and herbaceous weeds and have been pioneers in this region in the use of 'pulse grazing', along with experimental use of fire to reduce the dominance of introduced species. Pulse grazing is also known as 'high density short duration', 'time-managed' or 'crash' grazing. Stock are introduced when most weeds are actively growing and prior to setting seed, but before most native species, and particularly native grasses, are actively growing and setting seed. In the past 10 years, John and Moira have observed the steady decline of high threat environmental weeds and the re-establishment of native species. Of the 90 native species recorded to date in Bowman Park, an incredible 35 species or almost 40% have a conservation rating, including three State Rare and four State Vulnerable species.

Bushland Condition Monitoring

In 2004, the opportunity to monitor and quantify the vegetation changes which had been qualitatively noted in Bowman Park was recognised: as part of trialling the then emerging *Bushland Condition Monitoring Method* (Croft, Pedler and Milne 2005), two monitoring quadrats were established on **25th July 2004**. The quadrats are 30 m x 30 m and the corners of the quadrats are marked by wooden stakes. This has enabled exactly the same area to be surveyed using the same method on two subsequent occasions - **29th July 2006** and on **8th September 2007**. On all occasions the survey effort and recorders were the same. Sonia Croft was the primary recorder, with assistance by John Samuel-White and Tim Croft. Both sites are part of a larger area that is pulse grazed at frequencies varying from at least once a year to once every two years. On each occasion grazing duration is between 1 to 2 days.

BCM Quadrat 1: Blue Gum Grassy Open Woodland

Quadrat 1 is within an area of Blue Gum Grassy Open Woodland. The understorey is dominated by a grassy, herbaceous and tussocky ground layer with shrub species present but naturally sparse.

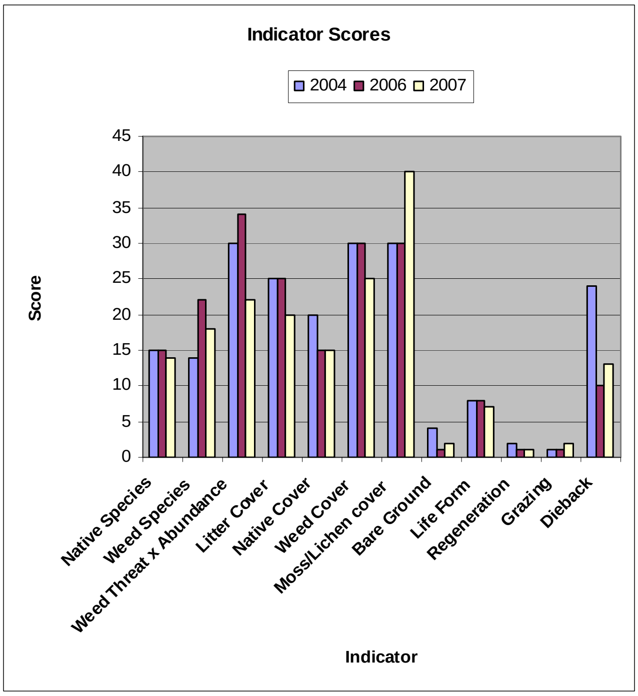
Condition Indicator Values

Condition Indicator	2004	2006	2007
Number of Native Species	15	15	14
Number of Weed Species	14	22	18
Weed Threat x Abundance*	30	34	22
Litter Ground Cover (%)	25	25	20
Native ground cover (%)	20	15	15
Weed ground cover (%)	30	30	25
Moss/Lichen cover (%)	30	30	40
Bare Ground cover (%)	4	1	2
Life Form Structural Score	8	8	7
Regeneration: Number of woody trees and shrubs	2	1	1
Grazing: Number of species obviously grazed	1	1	2
Average Tree Dieback %	24	10	13

** value derived from the sum of (the cover of weed x a threat rating) for the five most abundant weeds*

For most condition indicators, Quadrat 1 appears to have changed only marginally between 2004 and 2007 with the number and abundance of native species being similar, as were the estimates of cover for individual ground cover components. However, species composition has changed slightly with some species not initially recorded becoming evident and others no longer occurring in the quadrat. These changes may partly reflect seasonal climatic fluctuations and natural cycles in population numbers. Three species were recorded in the quadrat for the first time in 2007.

Whilst the 'weed threat and abundance' score is still relatively high for the quadrat, there are indications that this score is steadily declining, with the cover of high threat weeds reducing. Perennial Veldt Grass, Phalaris, Lippia, Rice Millet and Bridal Creeper which were present in 2004 and/or 2006 were all absent in 2007, presumably



due to targeted spraying of these weeds. Time-managed grazing has probably also reduced weeds such as Phalaris.

Very little change was recorded in the native plant structure. The native plant structural complexity of the quadrat has remained relatively simple, with only five or six distinct native life forms represented on all monitoring visits. This is a reflection that the area is still in the early to mid stages of recovering from past high disturbance that resulted in the area being almost completely dominated by introduced species.

There has been no large scale change in the number of species of woody trees and shrubs, nor in the number of individuals regenerating. The lack of regeneration is likely to be due to a combination of unusually dry years in 2006 and 2007, and grazing pressure from both sheep and rabbits. Whilst the 'pulse' grazing of sheep appears to be effective in reducing the cover of several exotic grasses and herbaceous species, which has possibly enabled an increase in native grass cover, grazing may also be limiting natural regeneration of native woody species and some other native herbaceous species.

Quadrat 1: Year 2007 *Photo:* Sonia Croft

As the quadrat was surveyed twice following high intensity short term grazing, it is not surprising that the small number of palatable species in the quadrat showed signs of being obviously grazed on each monitoring visit. When grasslands are being actively managed using grazing as a tool, it is a difficult to achieve the optimal balance between reducing weed biomass, while still allowing for the regeneration of native species. In this recovering habitat at Bowman Park, where woody trees and shrubs are likely to have been naturally sparse, regeneration of woody species may also be naturally of limited scale.

The greatest recorded change was an improvement in tree health between 2004 and 2006 (measured by estimating dieback of trees). However, the recorded differences in tree health are believed to be a combination of differences in observer perceptions and seasonal fluctuations.

BCM Quadrat 2: Blue Gum grassy Woodland with scattered Buloke and Grey Box trees.

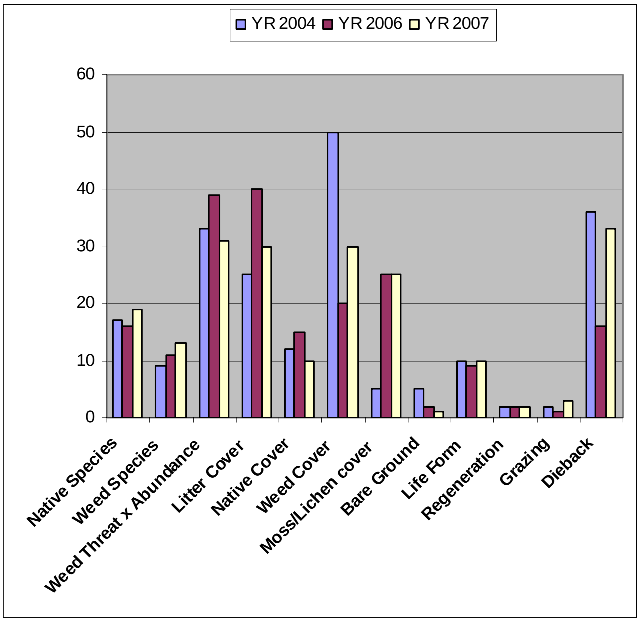
Quadrat 2 is also a Blue Gum Grassy Woodland but includes scattered Buloke and Grey Box trees. This area contains a higher number of understorey shrubs and small trees, particularly Golden Wattle compared with Quadrat 1 area. The ground layer, however, is again the prominent understorey layer with a high cover of native grasses, herbs and tussocks.

Condition Indicator Values

Condition Indicator	2004	2006	2007
Number of Native Species	17	16	19
Number of Weed Species	9	11	13
Weed Threat x Abundance*	33	39	31
Litter Ground Cover (%)	25	40	30
Native ground cover (%)	12	15	10
Weed ground cover (%)	50	20	30
Moss/Lichen cover (%)	5	25	25
Bare Ground cover (%)	5	2	1
Life Form Structural Score	10	9	10
Regeneration: No of woody trees and shrubs regenerating	2	2	2
Grazing: Number of species obviously grazed	2	1	3
Average Tree Dieback %	36	16	33

** value derived from the sum of (the cover of weed x a threat rating) for the five most abundant weeds*

Bushland Condition Monitoring of Bowman Park, Bordertown Parklands cont.



After allowing for up to 10% variation due to variability in observer perception between visits, most condition indicators scores did not change significantly over the three monitoring visits. The species diversity, regeneration and grazing indicators can perhaps be quantified most accurately as these indicators do not require an estimate of cover, which can be difficult to estimate accurately. These indicators of species diversity, regeneration and grazing showed very little change between 2004 and 2007. The main change in species composition was in the presence or absence of annual species, which is likely to reflect seasonal conditions.

The indicators which appear to have shown an improvement in condition are total weed cover, amount of bare ground and the 'weed threat x abundance' score, although additional monitoring is required to determine if these are long-term trends. As with Quadrat 1, the weeds actively controlled with spot-spraying (Plantain, Annual Veldt Grass, Bulbous Meadow-grass and Sour-sob) recorded an estimated decrease in cover in 2007.

Quadrat 2: Year 2007 *Photo:* Sonia Croft

Again, as with Quadrat 1, relatively large year-to-year changes were recorded in tree health, which is likely to be due to seasonal fluctuations, variation in observer perception and also long-term changes.

As with Quadrat 1, the levels of woody tree and shrub regeneration have been relatively low in Quadrat 2. The reasons for this may include a combination of: grazing pressure, naturally low ***levels*** of regeneration due to a naturally low density of trees and shrubs and naturally low ***rates*** of regeneration due to the relatively low rainfall levels during the survey period. Within the quadrat, grazing seems to be concentrated on the following natives: Golden Wattles, Black-anther Flax-lily, Leafy Stenophylla and Mat-rush.

Conclusion

The Bushland Condition Monitoring quadrats have recorded subtle changes in species diversity and abundance, weed cover and threat and grazing impacts, which may have gone undocumented or unnoticed without a formal monitoring system being in place. Overall, the survey quadrats and surrounding grassy woodland appear to be recovering steadily from past heavy disturbances with a moderate native species diversity now present. The cover and abundance of high threat weeds is also declining. Natural regeneration, however, has been limited in both quadrats, possibly due to both ongoing rabbit grazing and the pulse grazing of sheep.

The changes recorded in the quadrat are likely to be the result of short-term seasonal factors, variability in observer perceptions between monitoring surveys and active management leading to long-term changes in condition. Allowing for up to 10% variation in results due to observer variability and seasonal fluctuations, the monitoring data suggest that some of the changes are long-term changes showing an improvement in condition. Active targeted weed control and time-managed grazing both appear to be resulting in a decline in weed cover, in particular. However, the results reinforce the need for long-term monitoring to more fully distinguish short-term fluctuations due to seasonal differences and observer variability from longer-term changes in condition.

Reference

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Bushland Condition Monitoring Project Officer

2007 Survey Update – Biological values of the cemeteries of the South East.

Project Background

The value of remnant native vegetation in cemeteries and cemetery reserves throughout South Australia is incalculable. Cemeteries form a highly important part of a precious remnant network of natural habitat in many agricultural regions where virtually all native vegetation has been cleared.

This is particularly the case for the South-East of South Australia which has been identified by the Australian Government as a National Biodiversity 'Hotspot'. This identifies the region as rich in plant and animal species, particularly endemic species, that is under immediate threat from impacts such as land clearing, development pressures, salinity, weeds and feral animals. At a state and national level the significant natural values of cemeteries are being increasingly recognised (eg Robertson 2000; Mussared 1994). The biodiversity values of native vegetation remnants in these cemeteries include the provision of wildlife habitat and threatened species protection, biological reference of pre-European vegetation assemblages, in-situ seed bank and countless other heritage values.

These small but biologically diverse areas came under threat during 2006 with the announcement that the State Government were planning to amend the Native Vegetation Act 1991 through the introduction of the Draft *Native Vegetation Variation Regulations 2006*. These regulations included changes to the current classifications of cemeteries under the Act effectively giving local councils more power over the removal of vegetation in and around cemeteries in their districts. In response to these proposed changes the Society undertook a biological survey of the cemeteries in the South-east of South Australia as part of the 2007 NCSSA Survey.

The aim of the Survey was to survey the floristic and bird biodiversity assets of cemeteries in the South East of South Australia. The survey findings will be used to provide local councils with recommendations to conserve important native vegetation remnants and to inform councils of their obligations under the *Native Vegetation Act 1991* and the *Environment Protection and Biodiversity Conservation Act 1999*.

The project's methodology is based on the previously compiled NCSSA survey of cemeteries in the in the Mid-north of South Australia undertaken by Robertson (2000)* and includes:

- Identification of suitable sites
- Initial ground-truthing of selected sites and compilation of preliminary species lists and community descriptions
- Site prioritisation through comparative ranking of relative conservation values
- Implementation of quantitative biological audits of 15 sites using standard biological survey technique (as per Heard and Channon 1997)**
- Collation and processing of data
- Preparation of final report, which will include:
  - Description of methods
  - Map and listing of cemetery sites surveyed
  - Overview of biodiversity values of all sites
  - Ranking of sites in which comprehensive survey is undertaken
  - Plant species lists, including plants of conservation significance
  - Quadrat based biological survey data
  - Recommendations, principles and techniques for management
- Circulate report to relevant regional councils and Native Vegetation Council
- Provide data for entering onto South Australian Biological Survey database.

Preliminary Results

To date the Society has collected preliminary species lists and community descriptions from 25 cemeteries and has undertaken detailed biological surveys and bird surveys within 10 cemeteries using a total of 15 survey quadrats.

The following points outline some of the results of the preliminary data analysis, which has conclusively shown that cemeteries of the South East have significant biodiversity values.

- 201 indigenous plant species recorded during detailed biological survey of 15 cemetery quadrats.
- Of the 201 plant species recorded, one was classified as being Endangered, three were rated as Vulnerable and three were rated as Rare and under the *National Parks and Wildlife Act 1972*. Another 33 are of Regional Conservation Significance.
- A remnant stand of Buloke Woodland of the Riverina and Depression Bioregions was recorded at the Frances Cemetery. This community is listed as an Endangered under the EPBC Act.
- 60 bird species were noted, of which 53 were native
- Three bird species rated as Vulnerable under the *National Parks and Wildlife Act 1972* were noted, namely the Bush stone-curlew (*Burhinus grallarius*), which was recorded at two of the cemeteries surveyed, the Yellow-tailed Black Cockatoo (*Calyptorhynchus funereus*) which was recorded at one cemetery and the Rufous Bristlebird (*Dasyornis broadbenti*), recorded at two cemeteries

** Robertson, MA (2000) Mid-North Cemeteries and Reserves Vegetation Survey. Nature Conservation Society of South Australia, Adelaide.*

*** Heard, L. and Channon, B. (1997). Guide to a Native Vegetation Survey (Agricultural Region) using the Biological Survey of South Australia methodology.*

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NCSSA 2007 SE Survey—Mundulla Cemetery Photo: Tim Jury

Comparison of managed with unmanaged grassy woodland at Belair National Park

Tim Jury[1] & Sonia Croft[2]

Threatened Plant Action Group/NCSSA[1], NCSSA[2]

Introduction

Grassy woodlands are among the most threatened ecological communities in South Australia (Davies 1999, Paton *et al.* 1999). Few intact examples of grassy Manna Gum (*Eucalyptus viminalis* ssp. *viminalis*) and Messmate Stringybark (*E. obliqua*) woodlands remain in the southern Mount Lofty Ranges. These communities mostly occur along sheltered gullies with protected aspects in higher rainfall country and are characterised by relatively fertile soils and mesic[1] environmental conditions.
Such woodlands typically comprise understoreys of indigenous grasses, herbs, orchids, ground ferns, mat plants and low shrubs beneath a relatively open tree layer and sparse mid stratum (Davies 2004). Mesic grassy woodlands are inhabited by a distinctive group of rare or uncommon species seldom found in other vegetation communities. Most grassy woodland remnants in the region have become degraded through livestock grazing, biological invasions and anthropogenic[2] changes to ecosystem processes.

Belair National Park contains remnant examples of Manna Gum and Messmate Stringybark grassy woodlands that have become degraded through dense invasion by woody weeds, including: Sweet pittosporum; European Olive; Boneseed; Montpellier Broom; Hawthorn; Ivy and other exotics (DEH 2003, Mercer & Bond 2004). Extensive woody weed invasion has created a metastable[3], artificially dense, mid to tall shrub layer and an understorey substantially diminished in native species diversity. The declining understorey includes the nationally vulnerable Leafy greenhood orchid (*Pterostylis cucullata*) and Clover glycine (*Glycine latrobeana*), as well as several regionally rare or uncommon plant species. Weed invasion is listed as a key threat to the Leafy Greenhood (Quarmby 2006).

This article contrasts the condition for areas of grassy woodland that have received sustained weed management with adjoining unmanaged areas of the same woodland at Belair National Park. A 'snapshot' comparison of vegetation attributes is provided to depict differences between managed and unmanaged sites and as some indication of project progress. Results and relevant management issues are discussed below.

[1]**Mesic**: refers to a moderate or more regular availability of moisture.

[2]**Anthropogenic**: caused or produced by humans

[3]**Metastable**: a transient but relatively long-lived state that continues unless sufficiently disturbed to pass to a more stable state of equilibrium.

Method

The Threatened Plant Action Group (TPAG) and partner organisations commenced minimum-disturbance weed control measures (per Robertson 2005) in two main areas of grassy woodland in Belair National Park from 1995 (Davies 1995). Leafy greenhood occurs at both sites and the objectives of management were primarily to restore habitat for this threatened orchid as well as reinstating woodland composition by reducing weed cover and competition to assist regeneration of indigenous plants (Mercer & Bond 2005). When weeding began managed sites were uniformly dominated by woody weeds. While such densely infested bushland is not often targeted by bushcarers, due to a prevailing philosophy of prioritising areas of least invasion, TPAG recognised that if this principle was uncritically accepted these important sites wouldn't receive the active management required to maintain their conservation values.

As part of evaluating the efficacy of weed control, actively managed areas were paired with adjoining, unweeded 'reference' sites and assessed for condition using methods in Croft, Pedler and Milne (2005). The two managed areas are known as the Tennis 'Court 37' site which contains grassy Manna gum woodland; and the Long Gully 'Tank' site which contains grassy Messmate Stingybark woodland. The Leafy greenhood (*Pterostylis cucullata*) occurs at both sites (Bond & Quarmby 2007).

Vegetation monitoring quadrats (30x30m) were established in 2 separate areas of actively weeded grassy woodland and in adjacent unweeded sections of the same woodland (managed sites paired with unmanaged equivalents). Vegetation attributes were recorded for all sites, including: vegetation structure; ground cover components; species composition and tree health. In both cases, the reference (unmanaged) site was located within 100m of weeded sites in nearby areas containing the same vegetation association (per Specht 1972) and considered representative of managed areas with respect to slope, soils, aspect, and characteristic plant species.

Results

Manna Gum Association: Tennis Court 37

The weeded site scored more favourably for the following condition indicators: higher native species diversity, lower weed cover, lower weed threat score (incidence of 'high threat' weeds) and better tree health. Of the 48 native species present in the weeded site, eight have a

Photo 1 & 2. Weed managed vs. unmanaged Manna gum association (Court 37 site) **Photo: Tim Jury**

conservation rating compared with 29 native species recorded at the unweeded site, of which two have a conservation rating. A further difference between the weeded and unweeded survey sites was tree health. The health of the 10 adult trees, including dead trees, nearest to the permanent monitoring post was recorded at both sites. In the weeded site, all trees had an estimated dieback of less than 20%, whereas in the unweeded site, there were four dead trees, and eight trees had an estimated dieback of 80% or more. The average canopy dieback was 15% and 80% respectively.

The greatest scope for further improvement in condition of the actively weeded site is in: overall cover of all weeds and in particular, high threat weeds; regeneration of native woody species, especially of Manna Gums, and continued increase in life form structural complexity, primarily by an increase in the cover of native plants within each life form.

The weed with the greatest cover at the weeded site was the relatively low threat annual grass, Quaking Grass (8%), whereas at the unweeded site, the high threat woody weed, Boneseed, covered an estimated 20% of the survey quadrat. Although total weed cover was less at the weeded site 12 'high threat' weed species were recorded compared with seven for the unweeded site. Presumably this is due to the removal of large woody weeds which has opened up space for secondary invasion by additional species, albeit at relatively low densities. Also, although there were few adult woody weeds present in the weeded site, seedlings of Boneseed, in particular, were numerous with several hundred estimated.

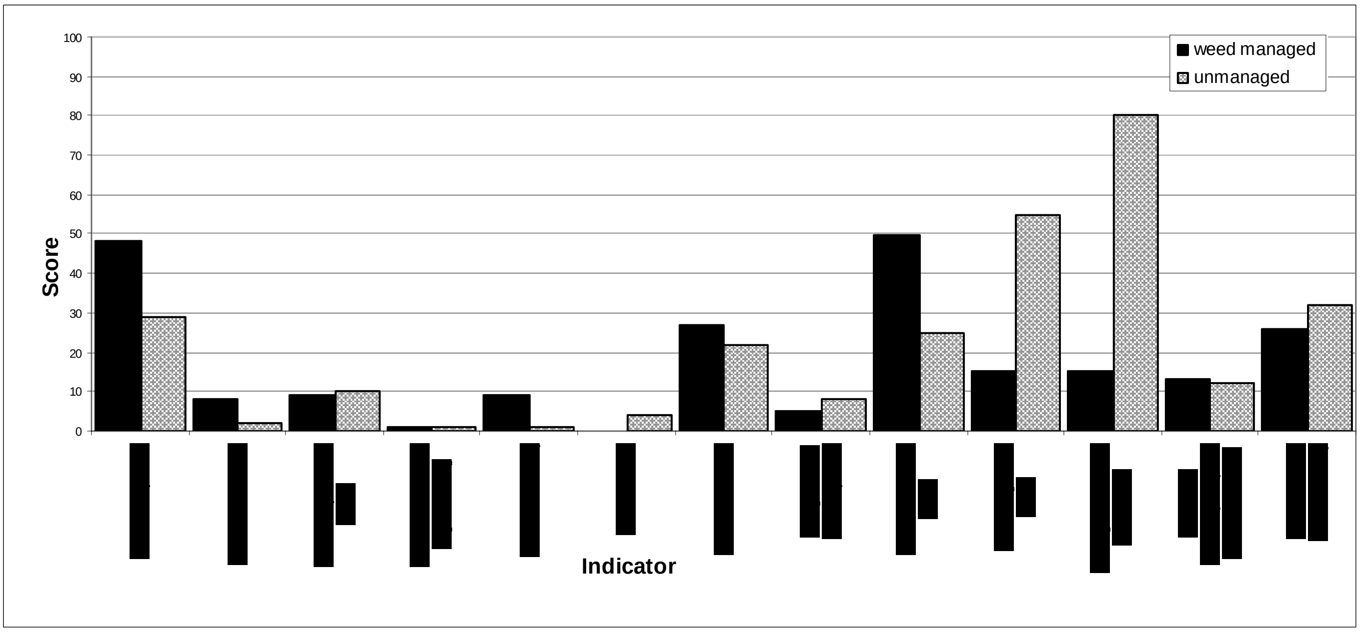

Figure 1: Vegetation condition indicators for 'Court 37' site (Manna gum association)

Comparison of managed with unmanaged grassy woodland at Belair National Park cont.

Photo 3 & 4. Weed managed vs. unmanaged Stringybark association (Tank site) **Photo: Tim Jury**

Messmate Stringybark Association: Long Gully Tank

The most apparent differences between the weeded and unweeded sites were in native species diversity, weed and native ground cover, and tree health. In addition, the weeded site displayed a noticeable improvement in woodland structural diversity compared with the unweeded site. As with the Manna Gum association, not only was there a significant increase in native species diversity, 35 native species compared with 15 native species at the unweeded site, many of the additional species were also of conservation significance with nine rated species compared with two at the unweeded site. Native ground cover was also much higher at the weeded site – with approximately 50% of the survey site estimated to be covered by native species, mostly native herbs, ferns and Weeping rice-grass. The difference in tree health was also marked. At the unweeded site, two of the ten trees recorded were dead and the average estimated canopy dieback was 37%. This compares with no dead trees in the weeded site and a lower average of 12% for canopy dieback.

Box 1: Indicator explanations

*** rated species:** those of conservation significance for the Southern Lofty Botanical Region.

† habitat trees: based on presence of hollows, tree size & canopy health.

ψ weed cover & threat score: the sum of percent cover x invasive threat category (for high threat weeds). The lower the score the lower the threat.

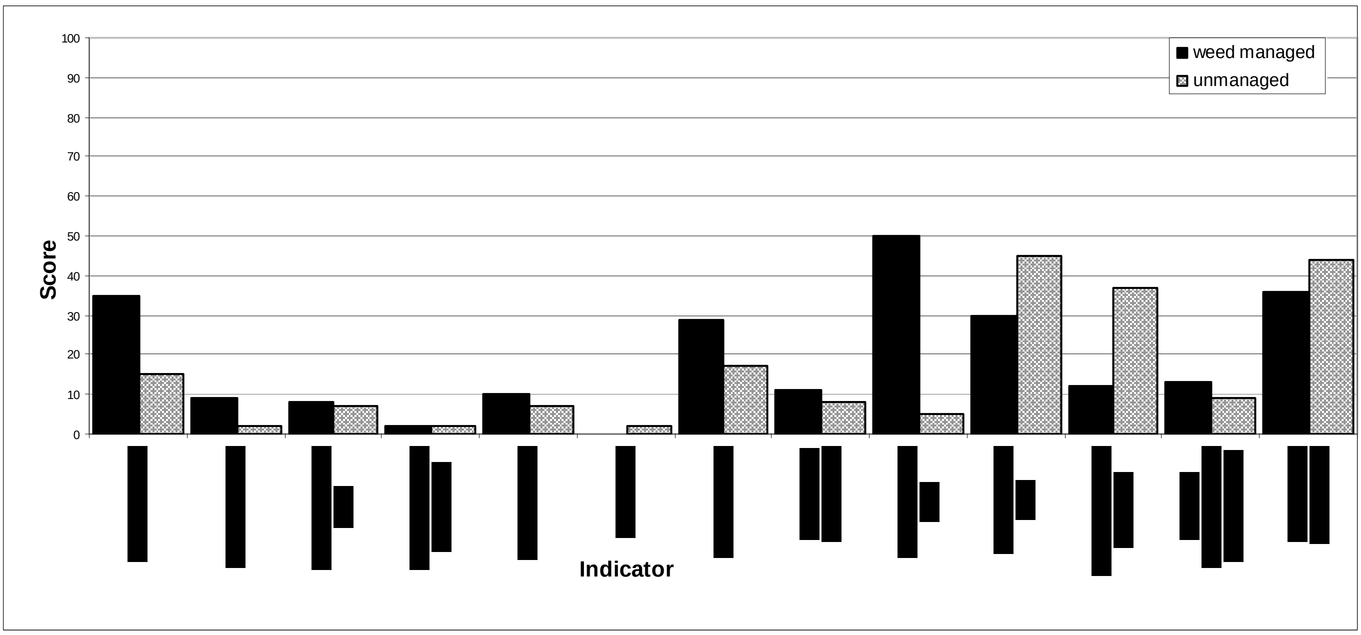

Figure 2: Vegetation condition indicators for 'Tank' site (Messmate stringybark association)

At the actively managed site, the weed species with the greatest cover/abundance was Ivy, which was estimated to cover about 10% of the survey quadrat. The next greatest cover/abundance weeds were Broom, Vetch, Cleavers and Cocksfoot grass. In stark contrast, at the unmanaged site, Montpellier broom was the weed species with the greatest cover/abundance, estimated to have an 80% cover. This was followed by Cleavers, Sweet Pittosporum, Olive and Blackberry species. As with association 1, the decline in weed cover appears to have opened up space for secondary invasion by other weed species, but again at lower overall cover/abundances. Both the weeded and unweeded sites had a very high weed threat score, as a number of high threat weeds remained in the weeded site.

Discussion

Staged, selective removal of weed cover has resulted in vigorous regeneration of native herbaceous, fern and grass components. Of the native woody species, wattles showed the most prolific response to removal of weed cover. Opening up of habitat appears to have enabled secondary invasion of shorter lived weed species such as grasses and herbs or some expansion by persistent climbers (i.e. Ivy). While high threat weeds remain present in managed quadrats, as seedlings with low total cover, this situation is obviously preferable to mature woody weed thickets with respect to a lower overall ecological impact (dominance & competition pressure) as well as being a more tractable management proposition.

We have missed the opportunity to collect baseline data for actual weeded sites before commencing weed management which would have been preferable. Determining baseline condition would have enabled site responses to be directly recorded through time rather than inferred through comparisons with unmanaged areas. There are however many operational issues with managing degraded sites. The challenges of restoring weed dominated vegetation means it is imperative to harness volunteer enthusiasm without further delaying urgently required on-ground actions. The importance of ecological monitoring relative to pressing threat management actions may not always be appreciated by volunteers in this context (see Freeman 2004). There remains a strong need for scientists to become more involved in community-based restoration projects if monitoring is to be technically reliable and useful in evaluating changes brought about by management. Monitoring procedures however will need to be straightforward and time/cost effective if they are to be readily adopted by restoration practitioners.

The continuous, long-term weed control implemented at managed sites has resulted in improved native vegetation condition and biodiversity values. Results indicate that weed management is successfully restoring these woodland communities but also that ongoing weed management inputs will be required, albeit at lower intensities into the future. The comparisons made empirically support the spectacular visual impression that substantial restoration of actively managed woodland areas is occurring.

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Acknowledgements

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Plotless Vegetation Density Estimator - Field Trials Begin

December and January have seen the first field trials by NCSSA of plotless vegetation density estimators (PDEs) funded by the *Native Vegetation Fund Grants Scheme*. So far, we've tested three different techniques for measuring plant density at one field site. Data analysis has not yet been done but the trial process has provided some interesting early insights into the efficiency and accuracy of PDEs.

PDEs can be categorized roughly into point-to-plant and plant-to-plant measurement methods. The distances between randomly or systematically chosen sampling points and the plants of interest or the distances between neighbouring plants are used to give an estimate of the area occupied by a single plant. This can easily be converted to a plants-per-unit-area figure. The literature contains a broad diversity of PDEs that have been developed since the middle of the twentieth century. Many have been tested and compared using artificial population distributions and computer modelling. However, relatively less has been published about field use, especially under Australian conditions. PDEs require much less effort than traditional quadrat-based methods making them an ideal tool for rapid assessments. One criticism has been that results for plant populations with clumped or aggregated spatial distributions can be unreliable.

A review of the literature and a desktop assessment resulted in the following three techniques being selected for the trials:

1. Point Centred Quarter (PCQ) (Cottam *et al.* 1953) is expected to be a good all-round method to suit plant populations with varying spatial distributions. It yields a relatively large amount of data for each sampling point but takes longer to complete than some other methods. The area around the sample point is divided into four equal quadrants and the distance is measured to the individual within each quadrant nearest to the point.

2. Corrected Point Distance (CPD) (Batcheler and Bell 1970; Laycock and Batcheler 1975) method should be somewhat quicker than PCQ but it yields less data per sampling point. It also requires more complex data analysis but should be more accurate for plants with an aggregated spatial distribution. From the sample point, the distance to the nearest plant, the distance from that plant to its nearest neighbour, and the distance from the nearest neighbour to its nearest neighbour, exclusive of the first plant (in each case) is measured.

3. Triangular Tessellation (TT) (Ward 1991) should be the quickest method of the three in most situations but probably provide the least statistical power as it requires three measurements to produce one data point. However it should be ideal where a rapid density estimate is required, particularly for dominant plant life forms. The estimate comes from a measure of distances between the three plants closest to the sample point.

The field trial site was an area of shrubby grassland in the Hindmarsh Tiers area. It featured a successional regeneration gradient between a wooded remnant creek line and a cleared and previously grazed broad ridge. This provided an opportunity to test the methods on up to seven different plant life forms across a range of densities and spatial distributions.

As expected, PCQ consistently took longer than the other two methods to complete. There were also few instances where the plant spacings measured did not seem to be representative of their overall densities.

With the TT method, the distances measured also seemed representative of the overall plant spacings for the most dominant plant life forms. Grasses, shrubs and mat forming plants appeared to be the most uniformly distributed life forms and it is expected that the results from the TT method for these groups will be similar to those from PCQ. Some other life forms such as ferns and yaccas (*Xanthorrhoea*) were noticeably clumped. In their case, TT was expected to give a severe overestimate of plant density. This was because the triangle formed by the three closest plants to the sampling point was often very small and quite far from the sampling point. In other words the distance between the sampling point and the nearest clump of plants was not taken into account. The opposite problem could potentially occur with PCQ where the distance is measured from more than one sampling point to the same plant thus resulting in an underestimate of plant density in clumped distributions.

The CPD method seemed to be much better suited to the problem of clumped spatial distributions. This was because the ratio between the first, second and third distance measured reflected the level of aggregation of the plant distribution. Clumped distributions would usually have a long first distance followed by two shorter distances. More uniform plant distributions usually gave three comparable distances. These ratios can be used to formulate a correction factor to account for the strength of the spatial distribution pattern.

Cryptic or rare plant life forms were a problem for all of these methods. Searching time was heavily skewed towards locating such plants as small sedges and rushes in what was essentially a grassland community. Once a plant was found it was difficult to be sure that it was the nearest plant to the sampling point or neighbouring plant according to methodologies. This was particularly difficult in PCQ where the search was restricted to quadrants

around the sampling point. It must be remembered however that this problem is not unique to plotless methods.

Data analysis will reveal more information about the accuracy of each of these methods and their usefulness in different kinds of applications. It is expected that PCQ will give overall the most accurate and reliable results and that TT and CPD will be useful rapid estimators for more uniform and clumped spatial distributions respectively.

The Hindmarsh Tiers site has provided the opportunity to see how the methods perform across an apparent plant density gradient. The next step is to trial all of these methods at a different site. In theory, a site that has more consistent plant densities will allow a meaningful comparison of reliability or statistical power between methods. Further to this, the accuracy of the methods may be assessed by comparing them with 100% census counts or larger scale quadrat samples. A full report will be published in *Xanthopus* later this year.

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Craig Gillespie
Plotless Density Counts Project Officer

NCSSA Conservation Biology Grant 2008

Attention research students, applications are now open for the Society's 2008 Conservation Biology Grant.

The grant aims to assist honours and post-graduate level student research into aspects of conservation biology. Funds are available for research aimed at: improving understanding of the conservation status of species or ecological communities; providing recommendations for improvement of some aspect of biodiversity conservation; understanding the ecology of species or communities; and understanding threats to biodiversity and management of those threats.

The Conservation Biology Grants aim to extend the excellent work undertaken by research students on aspects of the biodiversity of South Australia. Previous grants have contributed to research into diverse topics including studies of the ecology of single species and assemblages (eg. systematics and phylogeography of stone geckos; and guanophillic arthropod ecology and conservation in bat caves), interactions between ecosystem components (eg mistletoes in Pink Gum Woodlands; and the importance of hypogeal fungi in the diet of bettongs) and the effects of human interactions with biodiversity in South Australia (eg. ecotourism as a means of encouraging ecological recovery and conservation).

The application process is simple and asks for only a brief outline of the research to be undertaken. Guidelines and application forms are available on the NCSSA website: *www.ncssa.asn.au*

The closing date for applications for the 2008 Conservation Biology Grant is **1st April 2008.**

2007 Conservation Biology Grant recipients were:

Jennifer Munro	Flinders Ranges Scorpion *(Urodacus elongatus)*
Wahi Afzan Azmi	Effect of the removal of exotic willows on the invertebrate communities

Grassland Management Trials at Caurnamont, River Murray SA

Bill New of the Nature Conservation Society of South Australia's Eastern Flanks Grassy Ecosystems Extension Project and Aimee Linke of the Mid Murray Local Action Planning Association are carrying out grassy ecosystem management trials at Caurnamont, River Murray South Australia.

Both Aimee and Bill participated in the 5th Stipa National Native Grasses Conference and prepared a poster and article, for the conference proceedings, to introduce the grassland management trials. Following is the article as presented in the conference proceedings.

Fungi, Herbicide, Snail Bait and Rabbit Exclusion in Grassland Management Trials

Aimee Linke, Mid Murray Local Action Planning Association Inc.
PO Box 10, Cambrai, SA 5353

Bill New, NCSSA - Grassy Ecosystems Extension Project
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Introduction

Many degraded grassland sites of the South Australian Murray Darling Basin have Onion Weed (*Asphodelus fistulosus*), rabbit and snail infestations. It is considered that these factors may inhibit recovery of native grasses by suppressing regeneration. The broad objective of this trial is to improve the understanding of management of degraded grassland sites around Purnong and Caurnamont, by evaluating the effects of rabbit exclusion, herbicide application, snail baiting, and native fungi on native grass and onion weed densities on site.

Study Area

The trial site is on a property at Caurnamont located on Craignook Road 1km North West of Purnong, River Murray South Australia. The property owners have set the land aside for conservation purposes. This site is similar to many other properties in the region as it has:

- alkaline sand over limestone
- degraded native vegetation consisting predominantly of a few species of native grass
- onion weed and annual grasses as the main weeds.

Thus it is expected that results from this trial could be extrapolated more broadly to other similar sites.

The trial is on the mid slopes of the property, above the wetlands and below the high country.

All of the replicate plots are placed generally mid slope with slope varying from 5- 15 degrees. Aspect of the trial site is northerly with all treatments and replicates to be orientated with the slope.

Previous history of the site has included grazing and cropping prior to the late 1950's. The site has recently (2004) been direct seeded with tree and shrub species, with site conditions resulting in poor success, although more germination has been noted while setting up this trial.

Methods

Treatments are applied for two management factors: rabbit exclusion and non-exclusion as the primary treatment with an additional treatment of either herbicide, snail bait, fungi or no-treatment (control). **Table 1** shows the plot layout where each treatment is applied to fenced and un-fenced plots. Treatments were allocated randomly and are paired for the fenced and un-fenced plots. The trial is repeated four times across the site, such that there are thirty two plots overall. Repeat plant counts within randomly placed 50cm X 50cm quadrats will be used to determine changes in average plant density. Three quadrats have been established per treatment plot. Photo point monitoring of each plot was also established and will be carried out at the same time as the plant density counts.

Table 1 Treatment allocation in repetition plots, example repetition 1

Snail Bait Fenced	Fungi Fenced	Herbicide Fenced	No Treatment (Control) Fenced
Snail Bait Un-Fenced	Fungi Un-Fenced	Herbicide Un-Fenced	No Treatment (Control) Un-Fenced

Rationale for treatments

Extensive rabbit activity is evident onsite with scratchings, dung patches and noticeable browsing damage on plants. The rabbit exclusion treatment will demonstrate the effect that rabbits are having on site and may also provide an indication of the worth of a broad scale rabbit control program that is currently operating in the region. It will also allow the observation of responses to the other treatments with and without rabbit disturbance.

Applying fungi treatment to plots Photo: Bill New

Onion weed is unpalatable to stock and favours disturbed sandy soils (Stretch 2002). It is a proclaimed plant in South Australia and is required to be controlled in parts of the state (DWLBC 2005). The chemical control of onion weed has been used in agricultural areas of South Australia, but not extensively in native vegetation management (Turner 1999). Herbicide control of onion weed in grassy ecosystems could be used as a process to assist with the restoration of these lands. Herbicide application will follow local best practice.

The infestation of common white snail (*Cernuella virgata*) and white Italian snail (*Theba pisana*) on this site is extensive. The application of snail bait for crop establishment is carried out in the region, however little work has been done in natural vegetation and remnant areas. It is considered that controlling snails on this site will assist with the regeneration of native grasses and other species that would have otherwise been eaten off by snails soon after germination. Snail bait application will follow local best practice using readily available products and dosages.

Fungi play an important role in ecosystem processes including nutrient cycling and plant and soil interaction. On degraded sites, local native fungi are often absent with the self re-establishment of fungi onto these sites being limited (CSIRO 2003). It is hoped that the reintroduction of local native fungi on to this site will improve the ecosystem processes and promote the health of the native plants present and the germination and establishment of new individuals to the site.

Discussion

Many agricultural pests are being noted as environmental pests that adversely affect the natural processes and structure of remnant vegetation. Competition, seedling predation and soil disturbance are resultant of pest plants, animals and insects that disrupt the natural processes such as seedling recruitment and nutrient recycling.

Many resources have been poured into research for the control and management of pests in agricultural systems with the control of the same pests in conservation systems having less or little consideration. This trial has been established to observe any response of agriculture based control techniques and the use of fungi in the restoration of natural systems.

No conclusions can be drawn at the early stages of this trial. If positive results are seen with these treatments at the study site, there is significant potential for similar techniques to manage other degraded grassland sites in the region.

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Reference:

Linke, A. & New, B. 2007, 'Fungi, Herbicide, Snail Bait and Rabbit Exclusion in Grassland Management Trials', *Native Grasses for a thirsty landscape. Proceedings of the 5th Stipa National Native Grasses Conference on the Management of Native Grasses and Pastures, 7th – 10th October 2007. Mudgee NSW.* O'Dwyer, C. (ed.). FLFR University of Melbourne, Dookie Campus, pp. 159- 161.

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GENERAL MEETINGS

will generally be held on the first Thursday
of every second month at the

Location: University of Adelaide, Mawson Building, Eric Rudd LectureTheatre
(The building on the corner of Victoria Dr and Frome Rd)

Upcoming meeting:

Thursday 8th May, 5:30pm nibbles for 6pm start

Past award winners of the **NCSSA Conservation Biology Grant**, and **BSSA Field Research Grant** present their research, and the 2008 winners are announced.

2007 NCSSA CBG: Wahi Afzan Azmi – Effect of the removal of exotic willows on the invertebrate communities in the River Murray, SA

2005 NCSSA CBG: Elisa Sparrow – The effect of population fragmentation and isolation on the reproductive biology, genetic status and population viability of wombats (*Vombatus ursinus* and *Lasiohinus latifrons*) in South Australia

2007 BSSA FRG: Udani Sirisena – Systematic studies on *Thysanotus*

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